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Behavioural health risks during early adolescence among perinatally HIV-infected South African adolescents and same-age, HIV-uninfected peers

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Abstract

Behavioural health risks, including substance use, early sexual debut, bullying and suicidality, are common during adolescence, but may be complicated among perinatally HIV-infected adolescents. However, there are few data exploring these behaviours in sub-Saharan Africa. We compared behavioural health risks (any self-report of substance use, sexual activity, bullying others or suicidality, or a positive urine toxicology screen) among perinatally-infected adolescents ages 9–14 years to that of an HIV-uninfected comparator group; and explored the effect of behavioural health risks on adolescent and caregiver report of adolescent suboptimal adherence (missed antiretroviral therapy dose(s) on 1 day during the preceding 30 days) and elevated HIV viral load (> 50 and > 1000 copies/mL in sensitivity analyses) in multivariable logistic regression models. Among 506 HIV-infected and 110 HIV-uninfected adolescents (median age overall: 12 years), 15% and 25% reported any behavioural health risk ($p=0.018$), respectively. Tobacco and other drug use was uncommon, while alcohol use was reported by 8% of HIV-infected versus 12% of HIV-uninfected adolescents ($p=0.185$). One HIV-infected (0.2%) and 3 HIV-uninfected adolescents (3%) reported any sexual activity ($p=0.019$). Among HIV-infected adolescents, report of any behavioural health risk was more common among male adolescents [adjusted odds ratio (aOR): 1.78; 95% confidence interval (CI): 1.08–2.95] and was associated with adolescent report

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of suboptimal adherence (aOR: 1.66; 95% CI: 0.99–2.78) but not with caregiver report of suboptimal adherence or with elevated viral load. In this group of perinatally-infected youth entering early adolescence, the prevalence of behavioural health risks was lower than that among same-age, HIV-uninfected peers. Longitudinal data are needed to explore the reasons underlying these differences, for example the possibility of more protective caregiving and supportive family environments, or of emotional and physical immaturity, as well as the emergence of risk behaviours over time in this population.

Keywords

Adolescent HIV; substance use; sexual activity; bullying; suicidality

Introduction

Adolescence is a critical stage of psychosocial and biological development, but poor self-control and impulsivity can lead to risky behaviours (Davidson, Grigorenko, Boivin, Rapa, & Stein, 2015). Experimentation, including substance use and sexual experimentation, is common and normative as adolescents age, but some adolescents may be at risk of developing substance use disorders (Davidson et al., 2015), and early sexual debut may predict later sexual risk behaviours (Heywood, Patrick, Smith, & Pitts, 2015; Sandfort, Orr, Hirsch, & Santelli, 2008). In addition, mental health problems such as suicidality (Bridge, Goldstein, & Brent, 2006; Hawton, Saunders, & O'Connor, 2012) and externalising aggressive behaviours such as bullying may be common (Craig et al., 2009). Notably, risky behaviours or mental health problems during early adolescence may precede more serious problems at an older age. Exploring the emergence, drivers and impact of behavioural health risks is critical to inform prevention efforts. In the current article, we use the term 'behavioural health risks' to include substance use, sexual activity, bullying others and suicidality.

These behaviours are complicated for perinatally HIV-infected adolescents who must navigate the normal developmental processes of adolescence while living with a stigmatised, sexually transmissible disease that requires adherence to lifelong antiretroviral therapy (ART). Perinatally-infected adolescents may delay experimentation due to emotional, cognitive or physical immaturity or factors such as more protective caregivers; conversely, they may engage in higher levels of risky behaviour due to impulsivity or judgement problems (Elkington, Bauermeister, Santamaria, Dolezal, & Mellins, 2015; Koenig, Nesheim, & Abramowitz, 2011). Onset of sexual behaviour in particular may be affected by factors such as pubertal delay (Elkington et al., 2012; Lowenthal et al., 2014) or low levels of HIV-status disclosure (Elkington et al., 2012; Toska, Cluver, Hodes, & Kidia, 2015). However, evidence is mixed, with studies from the United States reporting either similar (Alperen et al., 2014; Elkington et al., 2015; Mellins et al., 2011) or lower levels of behavioural health risks among perinatally-infected compared to HIV-uninfected adolescents (Elkington et al., 2012; Koenig et al., 2011).

In South Africa, behavioural health risks in the general adolescent population are prevalent, with a review reporting that 12% of youth aged 13–19 used alcohol for the first time before age 13 years (Ramsoomar & Morojele, 2012). Use of tobacco is similarly common, with school-based surveys reporting a prevalence of lifetime use between 23–60%, while the use of other drugs is lower, ranging between 15–25% for marijuana and 3–7% for methaqualone (Jonas, Crutzen, van den Borne, Sewpaul, & Reddy, 2016; Morojele et al., 2013; Plüddemann, Flisher, McKetin, Parry, & Lombard, 2010). Sexual debut before the age of 15 years has been reported in 16–18% of males and 5–8% of females (Pettifor, O'Brien, MacPhail, Miller, & Rees, 2009; Zuma et al., 2016). In school-based surveys, 10% of learners in grades 8–10 have reported bullying others in the past 12 months (Morojele et al., 2013), and 18–20% of learners have reported that they have thought about or made a plan to attempt suicide during the past 6 months (Jonas et al., 2016; Shilubane et al., 2013).

Although the emergence of behavioural health risks in the general adolescent population in South Africa is increasingly understood, there are few data describing mental health challenges and behavioural health risks among HIV-infected adolescents in this and other low- and middle-income countries (Vreeman, McCoy & Lee, 2017). Existing evidence suggests that emotional and behavioural challenges are common in this population, but few studies have included comparison groups (Mellins & Malee, 2013; Vreeman et al., 2017). Those that have suggest that levels of substance use are higher among behaviourally-infected compared to perinatally-infected adolescents in South Africa (Sherr, Cluver, Toska & He, 2018), and that suicidal behaviour is more common among HIV-infected adolescents in Rwanda compared to adolescents not affected by HIV (Ng et al., 2015). Given the burden of HIV in these settings, and the relative lack of data among perinatally-infected adolescents specifically, further research including appropriate comparisons is needed.

Notably, associations between behavioural health risks and suboptimal adherence to ART and elevated HIV viral load have been documented (Kim et al., 2017; Kuhns et al., 2016; Mellins et al., 2011), including associations between alcohol use and suboptimal adherence among adolescents in Zambia (Denison et al., 2018). If behavioural health risks are associated with poor ART outcomes, then their co-occurrence may place adolescents at even higher risk for poor health outcomes as well as HIV transmission to sexual partners, but further research is needed to investigate these relationships. We investigated behavioural health risks among perinatally-infected and same-age, HIV-uninfected adolescents in South Africa; and explored the associations between behavioural health risks and each of adolescent and caregiver report of adolescent ART adherence, and elevated HIV viral load.

Materials and methods

This cross-sectional analysis draws on enrolment data from the Cape Town Adolescent Antiretroviral Cohort (CTAAC), a longitudinal study of perinatally HIV-infected adolescents on ART and a comparator group of HIV-uninfected adolescents in Cape Town, South Africa.

Participants

For the CTAAC study, perinatally-infected adolescents were recruited from seven routine ART services across Cape Town and were eligible to participate if they were aged 9–14

years, had been on ART for >6 months, knew their HIV-status, and had no plans to relocate out of Cape Town during the study period. Adolescents in the HIV-uninfected comparator group were recruited from a youth centre in Masiphumelele, a low socioeconomic township in Cape Town. Frequency matching for age and gender was used, and these adolescents were recruited with parallel inclusion criteria to that of the HIV-infected group (aged 9–14 years and with no plans to relocate out of Cape Town during the study period). HIV-uninfected adolescents were selected independent of perinatal HIV exposure status, and underwent a rapid HIV test at enrolment to confirm their HIV-uninfected status. Written informed consent was obtained from primary caregivers prior to participation, and all adolescents were asked to provide assent. The study was approved by the University of Cape Town's Faculty of Health Sciences Human Research Ethics Committee (051/2013). Participants were reimbursed for costs associated with participation at study visits.

Measures

At enrolment, sociodemographic and clinical characteristics were assessed at a study visit separate from routine HIV care, and a physical examination was conducted, with parallel assessments for both HIV-infected and HIV-uninfected adolescents. A composite poverty score was calculated based on housing type, access to household assets and caregiver employment status (Brittain et al., 2018), with participants categorised into tertiles from most to least disadvantaged. Detailed clinical data, including ART history, was abstracted from the routine clinical records of HIV-infected participants by the study Medical Officers. At enrolment into the study, adolescent and caregiver report of adolescent ART adherence were assessed as the number of days on which adolescents missed ART dose(s) during the last 30 days; for the purpose of this analysis, suboptimal adherence was defined as missed dose(s) on 1 day, based on previous analyses suggesting that this is a valid measure of adherence in this sample (Brittain et al., 2018). HIV-infected adolescents underwent phlebotomy at the enrolment study visit for viral load testing (Abbott RealTime HIV-1) conducted by the South African National Health Laboratory Services.

Behavioural health risks (substance use, sexual activity, bullying and suicidality) were assessed using a paper-based tool ("Teen Talk") that was adapted from a questionnaire previously used among adolescents in South Africa (Cluver, Orkin, Boyes, & Sherr, 2014; Toska et al., 2017; Wild, Flisher, Bhana, & Lombard, 2004) and was formatted to be adolescent-friendly. The tool was designed to be self-administered with support from a trained interviewer, but was administered by the interviewer if adolescents struggled with literacy or completion. Adolescents were asked to report whether they had ever used a range of substances, including tobacco, alcohol, marijuana, methaqualone, inhalants (glue, petrol or thinners), cocaine, methamphetamines, heroin, stimulants and hallucinogenics. Where adolescents endorsed having ever used a particular substance, additional questions were asked regarding age at first use, recent use, and frequency of use. Adolescents were asked to report other behaviours that may harm themselves or others, including bullying others at school and attempts to hurt themselves during the past year. Suicidality during the past year was assessed as suicidal thoughts, telling someone about an intention to commit suicide, or suicide attempts. Adolescents were also asked to report whether they had ever engaged in any sexual activity (defined as any oral, vaginal or anal sex). Interviews were conducted in

participants' home language and separate from accompanying caregivers. A 6-panel urine toxicology screen was used to test for common illicit substances (marijuana, methaqualone, cocaine, methamphetamines, MDMA and opiates). Adolescents who screened positive for substance use or who self-reported any suicidal or high risk sexual behaviour were referred to local services providing support in this population.

Data analysis

Data were analysed using Stata 12 (StataCorp Inc, College Station, Texas, USA). We compared behavioural health risks between HIV-infected and HIV-uninfected adolescents using χ^2 tests or Fisher's exact tests in the case of sparse data. Among HIV-infected adolescents, we explored factors associated with any behavioural health risk and examined the effect of behavioural health risks on adolescent and caregiver report of adolescent suboptimal adherence (missed ART dose(s) on 1 day during the preceding 30) and elevated viral load (>50 copies/mL, and >1000 copies/mL in sensitivity analyses) in multivariable logistic regression models, controlling for age and gender as potential confounders. For the purposes of this analysis, we defined 'any behavioural health risk' as any self-report of substance use, sexual activity, bullying others or suicidality, or a positive urine toxicology screen. Although sexual activity may not necessarily represent a behavioural health risk, we included sexual activity in this definition given the young age of the adolescents in this analysis, and the finding that early sexual debut may predict later sexual risk behaviours (Heywood, Patrick, Smith, & Pitts, 2015; Sandfort, Orr, Hirsch, & Santelli, 2008).

Results

A total of 506 perinatally HIV-infected and 110 HIV-uninfected adolescents were enrolled between July 2013 and March 2015 and included in analysis. Reasons for exclusion among HIV-infected adolescents included incomplete "Teen Talk" questionnaire ($n=7$) and no urine toxicology screen ($n=2$); no HIV-uninfected adolescents were excluded.

Adolescent characteristics

The median age among HIV-infected and HIV-uninfected adolescents was 11.9 and 11.7 years, with 49% and 55% female, respectively (Table 1). The vast majority of adolescents in both groups were attending primary school, with a higher proportion of HIV-infected adolescents reporting that they have repeated one or more grades at school ($p<0.001$). Most HIV-uninfected participants (92%) reported that their primary caregiver was a biological parent, compared to 63% of HIV-infected participants ($p<0.001$). Pubertal onset (Tanner stage II or higher) and menarche were more common among HIV-uninfected compared to HIV-infected adolescents ($p=0.008$ and $p<0.001$, respectively). Among HIV-infected participants, the median age at ART initiation was 4.3 years, with a median duration of ART use of 7.7 years; 76% had viral load <50 copies/mL. Among 475 adolescents and 472 caregivers who had completed assessments of adolescent adherence, 30% and 24% reported suboptimal adherence, respectively.

Behavioural health risks

Overall, 15% of HIV-infected and 25% of HIV-uninfected adolescents reported any behavioural health risk ($p=0.018$; Table 2). Use of tobacco, marijuana or inhalants was uncommon in both groups (overall: 2%, 1% and 0.3% of adolescents), with no differences across groups. Alcohol use was more frequently reported, with 8% of HIV-infected and 12% of HIV-uninfected adolescents reporting having ever used alcohol ($p=0.185$). No adolescent in either group reported ever using other drugs. On the urine toxicology screen, 1% and 2% of HIV-infected and HIV-uninfected adolescents, respectively, tested positive for marijuana, and 0.8% of HIV-infected adolescents tested positive for methaqualone.

One HIV-infected adolescent (0.2%) and 3 HIV-uninfected adolescents (3%; $p=0.019$) reported a history of sexual activity. The HIV-infected adolescent reported not using a condom during their last sexual encounter, but condom use was reported by 2 of the 3 HIV-uninfected adolescents. Bullying others during the past year was reported by 4% of HIV-infected and 8% of HIV-uninfected adolescents ($p=0.096$). Self-harm and suicidal thoughts were uncommon, with a higher proportion of HIV-uninfected adolescents reporting self-harm (3% versus 0.4% among HIV-infected adolescents; $p=0.042$); and 1 adolescent in each group reported that they had attempted suicide during the past year.

Factors associated with behavioural health risks

Among HIV-infected adolescents, report of any behavioural health risk was associated with older age, male gender, and being in secondary (versus primary) school in unadjusted models (Table 3). After adjustment, report of any behavioural health risk was significantly associated with male gender [adjusted odds ratio (aOR): 1.78; 95% confidence interval (CI): 1.08–2.95], and was more common among older adolescents (aOR: 1.15; 95% CI: 0.98–1.33). Among HIV-infected adolescents who had completed adherence assessments ($n=475$), any behavioural health risk was associated with an increased odds of suboptimal adherence [odds ratio (OR): 1.69; 95% CI: 1.02–2.82; aOR: 1.66; 95% CI: 0.99–2.78 after adjustment for age and gender; Table 4]. No association was observed between any behavioural health risk and any of caregiver report of adolescent adherence, viral load <50 copies/mL or viral load >1000 copies/mL.

Discussion

Among perinatally HIV-infected South African youth entering early adolescence and a comparator group of same-age, HIV-uninfected peers (median age overall: 12 years), 1 in 7 HIV-infected and 1 in 4 HIV-uninfected adolescent reported 1 behavioural health risk (substance use, sexual activity, bullying others or suicidality), with report of any behavioural health risk significantly higher in the HIV-uninfected group. Use of tobacco and other drugs was low and comparable across the two groups, although almost 1 in 10 adolescents in each group reported having used alcohol. The prevalence of sexual activity and self-harm was low in both groups but each was significantly higher among HIV-uninfected adolescents; the proportion of adolescents reporting that they had bullied others was comparable across the two groups. Among HIV-infected adolescents, report of any behavioural health risk was

more common among male participants; and was associated with self-reported suboptimal adherence.

The proportion of HIV-uninfected adolescents reporting 1 behavioural health risk is notable. Given the young age of adolescents included, and the potential for the early initiation of risky behaviours to lead to later problems, we argue that young South African adolescents may be a high-risk group for adverse outcomes as they age into later adolescence. Notably, a lower prevalence of any behavioural health risk was observed among the perinatally-infected group, similar to the findings from some studies from the United States (Elkington et al., 2012; Koenig et al., 2011). Although we were unable to test the mechanisms of this association, several plausible explanations require consideration. First, more than half of the HIV-infected group reported having repeated a grade at school, compared to one-third of the HIV-uninfected group. In South African secondary schools, each grade includes a wide range of student ages due to grade repetition (Marteleto et al., 2008), and we hypothesise that being in a grade with younger peers may have influenced behaviours in the group of HIV-infected adolescents such that they engage in lower levels of risky behaviours. Second, perinatally HIV-infected adolescents may be sheltered by more protective caregivers (Koenig et al., 2011); in the current study, one-third of the HIV-infected group reported a primary caregiver other than a biological parent, and these complicated caregiving circumstances, coupled with a history of poor health, may have resulted in more protective caregiving. Third, frequent contact with health services may have bolstered supportive family environments in this group. Finally, we observed marked pubertal delay in the HIV-infected group, as is commonly observed in this group (Elkington et al., 2012; Lowenthal et al., 2014), which may result in delays in the onset of sexual activity in particular.

In the current study, only 1 HIV-infected adolescent reported a history of sexual activity. This is lower than the prevalence observed among perinatally-infected adolescents in Uganda, where a history of sexual activity was reported by 5% of adolescents aged 10–14 years and 41% of adolescents aged 15–19 years (Mbalinda, Kiwanuka, Eriksson, Wanyenze, & Kaye, 2015). The proportion of adolescents reporting tobacco and other drug use was similarly low in the current study, but school-based surveys in the country suggest rapid increases in substance use after the start of secondary school (Patrick et al., 2009). Prospective data are needed to determine whether these adolescents follow these same trends as they age. In this study, the prevalence of alcohol use, bullying and suicidality were consistent with other reported estimates among general adolescent populations in South Africa (Cluver, Orkin, Boyes, & Sherr, 2015; Liang, Flisher, & Lombard, 2007; Morojele et al., 2013; Ramsoomar, Morojele, & Norris, 2013).

The observed association between male gender and behavioural health risks is consistent with previous findings from general adolescent populations in South Africa (Jonas et al., 2016; Kaufman et al., 2014; Morojele, Brook, & Brook, 2016; Olumide et al., 2014; Ramsoomar & Morojele, 2012; Ramsoomar et al., 2013). We have previously reported that older, male adolescents in this cohort have a markedly high prevalence of elevated viral load (Brittain et al., 2018), suggesting that male adolescents may be at higher risk of both behavioural health risks and poor treatment outcomes, as well as HIV transmission to sexual

partners. Finally, the association between any behavioural health risk and adolescent report of suboptimal adherence is notable, although we did not observe an association with either caregiver report of adolescent adherence or viral load. Low to moderate levels of concordance between adolescent and caregiver report of adherence have been reported in this and other settings (Brittain et al., 2018; Dolezal, Mellins, Brackis-Cott, & Abrams, 2003; Evans et al., 2015; Farley et al., 2008; Usitalo et al., 2014), which may explain the contrasting findings across adolescent and caregiver report of adherence. Further, most of the responsibility for adherence still falls to caregivers at this young age (Brittain et al., 2018). It is possible that adolescent report of suboptimal adherence represents difficulty with taking ART, but that caregivers are ensuring that some level of adherence is maintained, thus adolescent report of missed doses may be a flag for later adherence issues.

These data have several limitations. The relatively young age of these adolescents (9–14 years) means that few reported behavioural health risks, making meaningful comparisons more difficult; and the urine toxicology screen only tested for recently used substances. Among the HIV-infected group, only adolescents who were engaged in routine ART services and who had been on ART for >6 months were enrolled. This group may differ from the broader population of perinatally-infected adolescents in the country, and their access to health services may partly account for the relatively low prevalence of behavioural health risks observed. Although the HIV-uninfected group was matched for age and gender, these adolescents had higher levels of socioeconomic disadvantage compared to the HIV-infected group. Finally, the behavioural health risks assessed are subject to the social desirability biases inherent in the assessment of all sensitive behaviours. However, we attempted to minimise this by administering an adolescent-friendly tool with support from trained fieldworkers. All interviews were conducted separate from accompanying caregivers and, for the HIV-infected group, separate from routine care services.

Despite these limitations, these novel data provide important initial insights into the emergence of behavioural health risks among perinatally HIV-infected youth entering early adolescence in South Africa. These data suggest that this group displays lower levels of behavioural health risks compared to same-age, HIV-uninfected peers, but comparable levels of substance use in particular. It will be critical to observe this population over time to assess whether this lower level of risk endures, possibly due to more protective caregiving or more supportive family environments through frequent contact with health services; or whether risk is simply delayed at this young age, possibly due to emotional and physical immaturity (Alperen et al., 2014). Longitudinal data are needed to explore the emergence of these behaviours over time as this cohort ages, reaches puberty and enters secondary school, as well as to further explore the impact of behavioural health risks on ART adherence and viral load.

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Table 1

Adolescent sociodemographic and clinical characteristics, by HIV-status

Variable	Perinatally HIV-infected – n (%)	HIV-uninfected – n (%)	P-value
Number of adolescents	506	110	
<i>Sociodemographic characteristics</i>			
Median age [IQR]	11.9 [10.7, 13.3]	11.7 [10.0, 13.4]	0.352
Gender – female	248 (49)	61 (55)	0.221
Ethnicity – Black/African	466 (92)	110 (100)	<0.001
Primary caregiver relationship			
Biological parent	317 (63)	101 (92)	
Other family member	136 (27)	6 (5)	
Non-family member	52 (10)	1 (0.9)	<0.001
Participant lives in a care facility	16 (3)	2 (2)	0.754
Housing type			
Informal	169 (33)	85 (77)	
House/flat	336 (66)	23 (21)	<0.001
Primary caregiver employed	265 (52)	87 (79)	<0.001
Poverty level			
Least disadvantaged	192 (38)	20 (18)	
Moderately disadvantaged	182 (36)	27 (25)	
Most disadvantaged	132 (26)	63 (57)	<0.001
Current level of education			
Primary school	447 (88)	93 (85)	
Secondary school	53 (10)	17 (15)	
Not in regular schooling system	6 (1)	0 (0)	0.222
Ever repeated a grade at school	288 (57)	36 (33)	<0.001
<i>Clinical characteristics</i>			
Tanner stage			
I	239 (47)	35 (32)	
II	124 (25)	31 (28)	
III	72 (14)	19 (17)	
IV	38 (8)	18 (16)	
V	24 (5)	6 (5)	0.008
Female adolescent has experienced menarche (n=309)	46 (19)	28 (46)	<0.001
Median [IQR] age at ART initiation	4.3 [2.0, 7.6]	-	-
Median [IQR] years on ART	7.7 [4.6, 9.2]	-	-
Adolescent report of adherence during preceding 30 days (n=475)			
No missed doses	334 (70)		
Missed dose(s) on 1 day	141 (30)	-	-
Caregiver report of adolescent adherence during preceding 30 days (n=472)			
No missed doses	358 (76)		

Variable	Perinatally HIV-infected – n (%)	HIV-uninfected – n (%)	P-value
Missed dose(s) on 1 day	114 (24)	-	-
HIV viral load			
<50 copies/mL	386 (76)		
50–999 copies/mL	56 (11)		
1000 copies/mL	63 (12)	-	-

Table 2

Adolescent behavioural health risks, by HIV-status

Variable	Perinatally HIV-infected – n (%)	HIV-uninfected – n (%)	P-value
One or more behavioural health risks¹	77 (15)	27 (25)	0.018
<i>Substance use</i>			
Ever smoked a whole cigarette – self-report	12 (2)	0 (0)	0.138
Median age when first smoked a whole cigarette (n=12)	13 years	-	
Smoked a whole cigarette during past year	7 (1)	-	
Smoked a whole cigarette during past month	4 (0.8)	-	
Ever drank alcohol – self-report	40 (8)	13 (12)	0.185
Median age when first drank alcohol (n=53)	12 years	11 years	
Drank alcohol during past year	14 (3)	4 (4)	
Drank alcohol during past month	6 (1)	1 (0.9)	
Ever smoked marijuana – self-report	6 (1)	2 (2)	0.638
Median age when first smoked marijuana (n=8)	13.5 years	12.5 years	
Smoked marijuana during past year	3 (0.6)	1 (0.9)	
Smoked marijuana during past month	1 (0.2)	1 (0.9)	
Ever used inhalants – self-report	2 (0.4)	0 (0)	1.000
Median age when first sniffed substances (n=2)	13 years	-	
Sniffed substances during past year	2 (0.4)	-	
Sniffed substances during past month	1 (0.2)	-	
Tested positive for any substance on urine toxicology screen	10 (2)	2 (2)	1.000
Tested positive for marijuana use	7 (1)	2 (2)	
Tested positive for methaqualone use	4 (0.8)	0 (0)	
<i>Sexual activity</i>			
History of any sexual activity – self-report	1 (0.2)	3 (3)	0.019
Median age at first sexual encounter (n=4)	12 years	13 years	
Used a condom during last sexual encounter (n=4)	0 (0)	2 (67)	
<i>Bullying others</i>			
Bullied someone at school during past year	22 (4)	9 (8)	0.096
<i>Self-harm and suicidality</i>			
Self-harm during past year	2 (0.4)	3 (3)	0.042
Suicidal thoughts during past year	5 (1)	1 (0.9)	1.000
Told someone about intention to commit suicide during past year	1 (0.2)	1 (0.9)	0.325
Attempted suicide during past year	1 (0.2)	1 (0.9)	0.325

¹ Behavioural health risks include all self-reported behaviors (substance use, sexual activity, bullying others, self-harm, and suicidality) and positive urine toxicology screen.

Table 3
Factors associated with behavioural health risks[/] among perinatally HIV-infected adolescents

Variable	No behavioural health risks – n (%)	One or more behavioural health risks – n (%)	Unadjusted odds ratio [95% CI]	P-value	Adjusted odds ratio [95% CI]	P-value
Age – median [IQR]	11.8 [10.6, 13.1]	12.3 [10.7, 14.0]	1.16 [1.00, 1.35]	0.054	1.15 [0.98, 1.33]	0.082
Gender						
Female	220 (51)	28 (36)	Reference		Reference	
Male	209 (49)	49 (64)	1.84 [1.12, 3.04]	0.017	1.78 [1.08, 2.95]	0.025
Primary caregiver relationship						
Biological parent	269 (63)	48 (62)	Reference			
Other family member	112 (26)	24 (31)	1.20 [0.70, 2.06]	0.504		
Non-family member	47 (11)	5 (6)	0.60 [0.23, 1.58]	0.297		
Poverty level						
Least disadvantaged	168 (39)	24 (31)	Reference			
Moderately disadvantaged	151 (35)	31 (40)	1.44 [0.81, 2.56]	0.218		
Most disadvantaged	110 (26)	22 (29)	1.40 [0.75, 2.62]	0.292		
Current level of education						
Primary school	383 (89)	64 (83)	Reference			
Secondary school	40 (9)	13 (17)	1.94 [0.99, 3.84]	0.055		
Not in regular schooling system	6 (1)	0 (0)	-	-		
Ever repeated a grade at school						
Never repeated a grade	188 (44)	30 (39)	Reference			
Repeated 1 grade	241 (56)	47 (61)	1.22 [0.74, 2.01]	0.428		

[/] Behavioural health risks include all self-reported behaviours (substance use, sexual activity, bullying others, self-harm, and suicidality) and positive urine toxicology screen.

Table 4

Association between behavioural health risks¹ and (A) adolescent report (n=475) and (B) caregiver report (n=472) of missed antiretroviral therapy (ART) doses during the preceding 30 days, and (C) HIV viral load (VL; n=505) among perinatally HIV-infected adolescents

<i>(A) Adolescent report of missed ART doses</i>						
Variable	No missed doses – n (%)	Missed dose(s) on 1 days – n (%)	Unadjusted odds ratio [95% CI]	P-value	Adjusted odds ratio [95% CI]	P-value
Age – median [IQR]	12.0 [10.7, 13.3]	12.2 [10.9, 13.5]	1.04 [0.92, 1.17]	0.537	1.03 [0.91, 1.16]	0.645
Gender						
Female	166 (50)	66 (47)	Reference		Reference	
Male	168 (50)	75 (53)	1.12 [0.76, 1.67]	0.565	1.07 [0.72, 1.60]	0.738
Behavioural health risks						
No behavioural health risks	288 (86)	111 (79)	Reference		Reference	
One or more behavioural health risks	46 (14)	30 (21)	1.69 [1.02, 2.82]	0.043	1.66 [0.99, 2.78]	0.052
<i>(B) Caregiver report of missed ART doses</i>						
Variable	No missed doses – n (%)	Missed dose(s) on 1 days – n (%)	Unadjusted odds ratio [95% CI]	P-value	Adjusted odds ratio [95% CI]	P-value
Age – median [IQR]	11.9 [10.7, 13.4]	12.2 [11.2, 13.3]	1.10 [0.96, 1.25]	0.161	1.10 [0.96, 1.25]	0.171
Gender						
Female	175 (49)	55 (48)	Reference		Reference	
Male	183 (51)	59 (52)	1.03 [0.67, 1.56]	0.906	0.99 [0.65, 1.52]	0.976
Behavioural health risks						
No behavioural health risks	303 (85)	94 (82)	Reference		Reference	
One or more behavioural health risks	55 (15)	20 (18)	1.17 [0.69, 2.06]	0.579	1.14 [0.65, 2.02]	0.642
<i>(C) HIV VL</i>						
Variable	VL <50 copies/mL – n (%)	VL 50 copies/mL – n (%)	Unadjusted odds ratio [95% CI]	P-value	Adjusted odds ratio [95% CI]	P-value
Age – median [IQR]	11.8 [10.6, 13.1]	12.5 [10.9, 13.7]	1.17 [1.03, 1.33]	0.017	1.16 [1.02, 1.32]	0.029
Gender						
Female	199 (52)	48 (40)	Reference		Reference	
Male	187 (48)	71 (60)	1.57 [1.04, 2.39]	0.033	1.51 [0.99, 2.31]	0.055
Behavioural health risks						
No behavioural health risks	329 (85)	99 (83)	Reference		Reference	

(C) HIV VL

Variable	VL <50 copies/mL – n (%)	VL 50 copies/mL – n (%)	Unadjusted odds ratio [95% CI]	P-value	Adjusted odds ratio [95% CI]	P-value
One or more behavioural health risks	57 (15)	20 (17)	1.17 [0.69, 2.03]	0.589	1.03 [0.59, 1.82]	0.910

/ Behavioural health risks include all self-reported behaviors (substance use, sexual activity, bullying others, self-harm, and suicidality) and positive urine toxicology screen.